

# Lightweight SiC-Composite Optics for Laser Applications

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## Statement of the problem:

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- Large optics used in high power chemical lasers are expensive and require cooling (CTE, thermal conductivity, MLD issues)
- High power solid state laser optics require cooling (CTE, thermal conductivity problem)

## Objective:

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- Demonstrate the use of SiC-based composite technology for laser applications

# Strategy

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1. Using rapidly producible SiC/Si structure to meet large scale production needs
2. Combining expertise in materials, composite , optical fabrication and testing to meet the need of industry.
3. Grouping existing technology together to shorten production time.

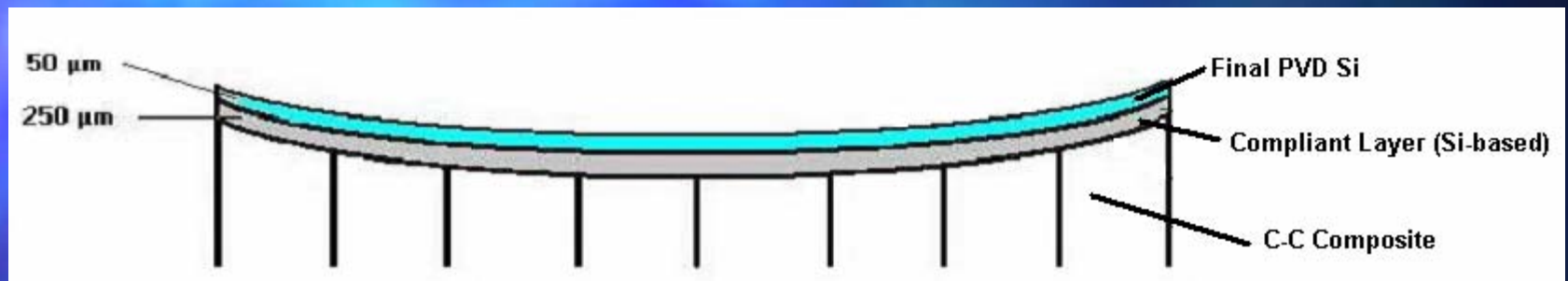


# Uniqueness of the Approach

- Chemical lasers

- Very high thermal conductivity C-C composite structure
- FGM C-SiC (Si) to tailor CTE, partially transparent
- PVD-Si (diamond turning)

# MER 1.5 meter Mirrors (chemical laser)



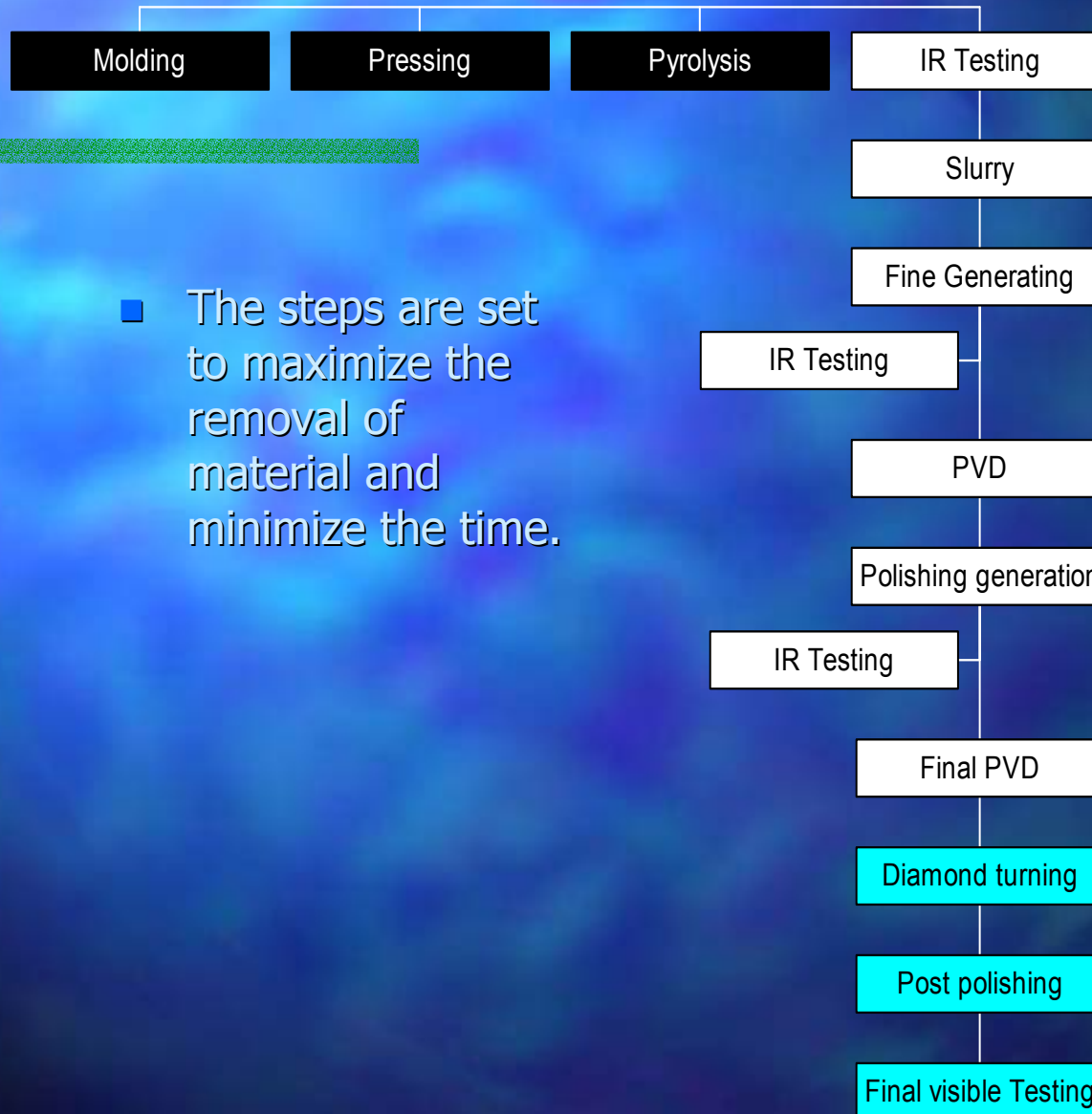
# Uniqueness of the Approach Solid State Laser

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- Use of high thermal conductivity, isotropic, near-zero CTE C-C composites
- Use FGM C-SiC (Si)
- Use of PVD-Si

# Process

## Steps:



- The steps are set to maximize the removal of material and minimize the time.

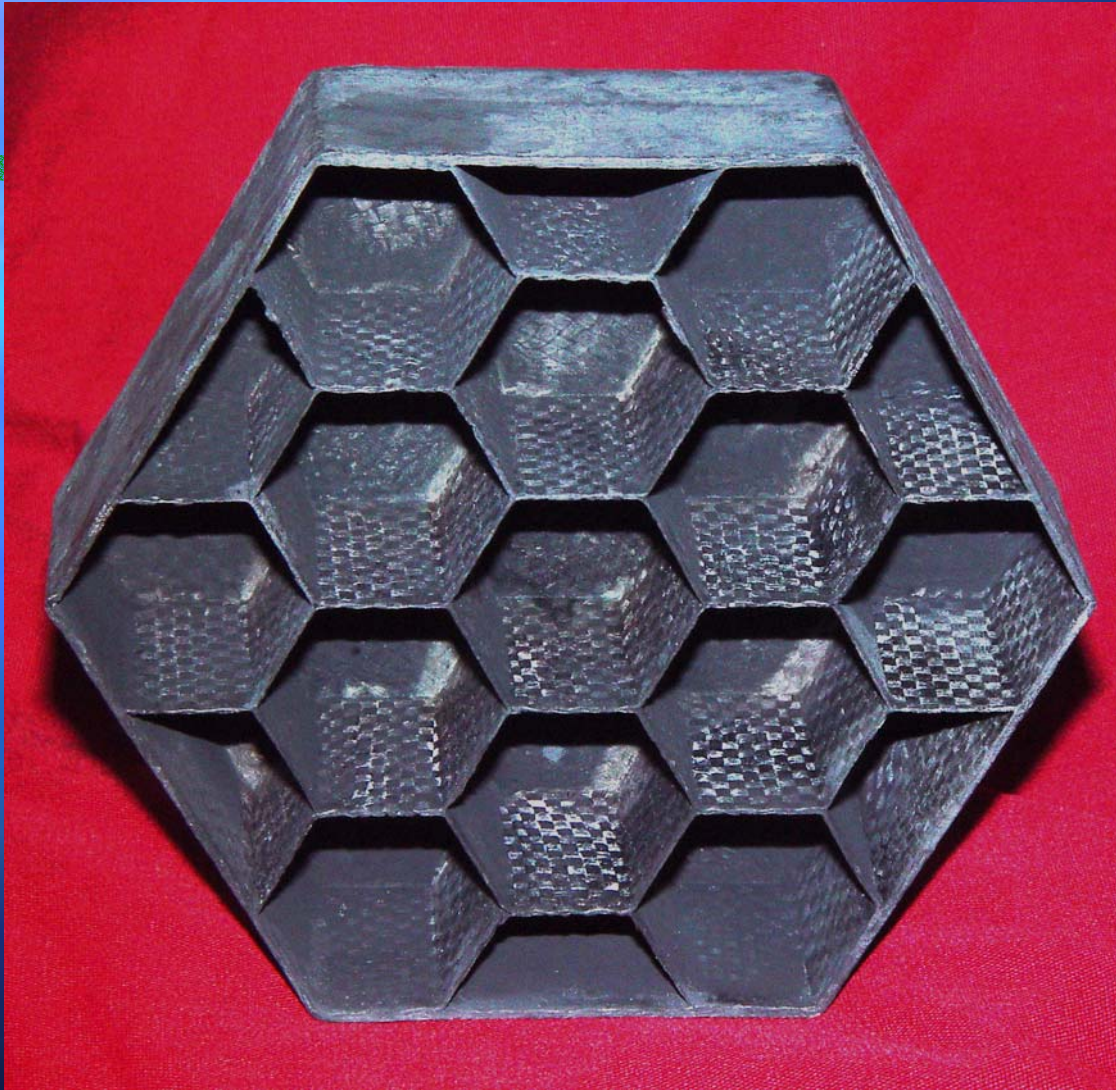


# Base Structures

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- 2-D pitch based fabric or 3-D preforms
- Hexagonal integrated honeycomb/face sheet
- Hybrid graphite / SiC matrix

## C-C Mirror Structure

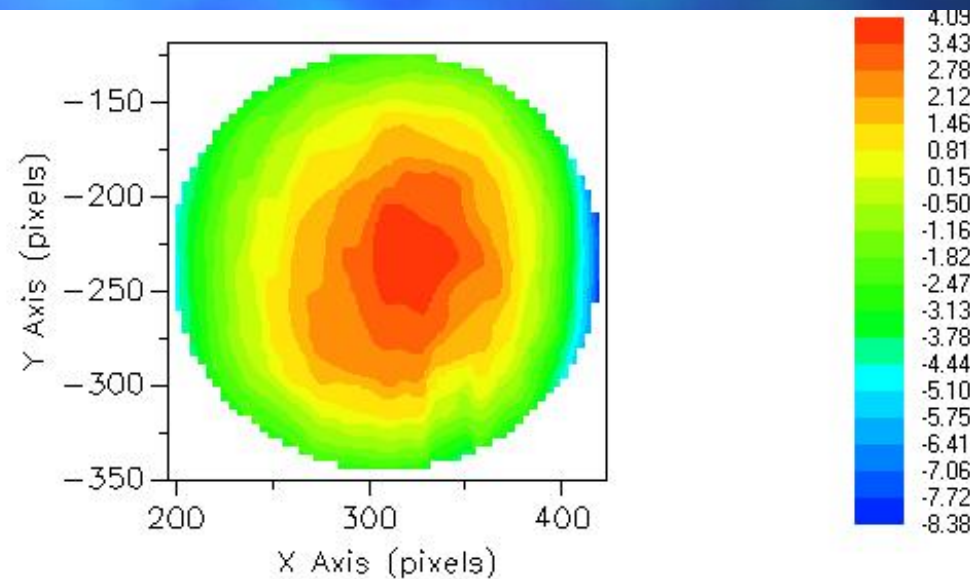




## Cross-Section of CVR-SiC C-C Composite



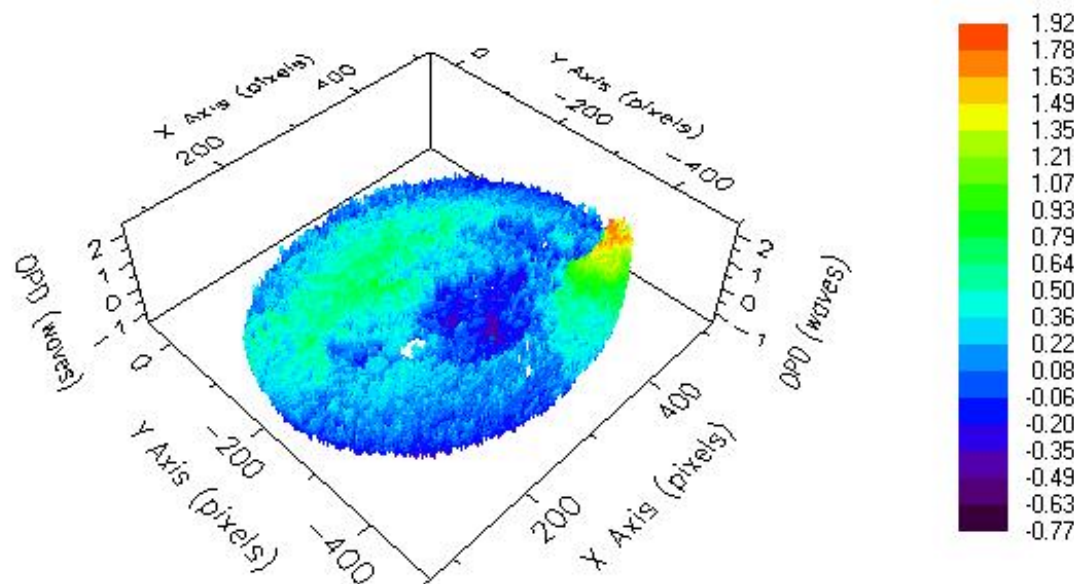
# IR Interferometer over 4" Aperature after Initial Grinding



Range (PV) = 14.0446 microns, RMS = 2.3838 microns, Strehl = 0.1353  
Analysis Aper: Pos[ 310, 232] Size[ 228, 228]



# IR Interferometer on 4" Aperture after Fine Polishing



Range (PV) = 2.6891 waves, RMS = 0.3114 waves, Strehl = 0.0217  
Analysis Aper: Pos[ 295, 243] Size[ 451, 451]

# Microroughness of Polished CVD-Si Surface



Mag: 50.9 X  
Mode: VSI

## Surface Data

Date: 01/22/20  
Time: 15:19:40

### Surface Statistics:

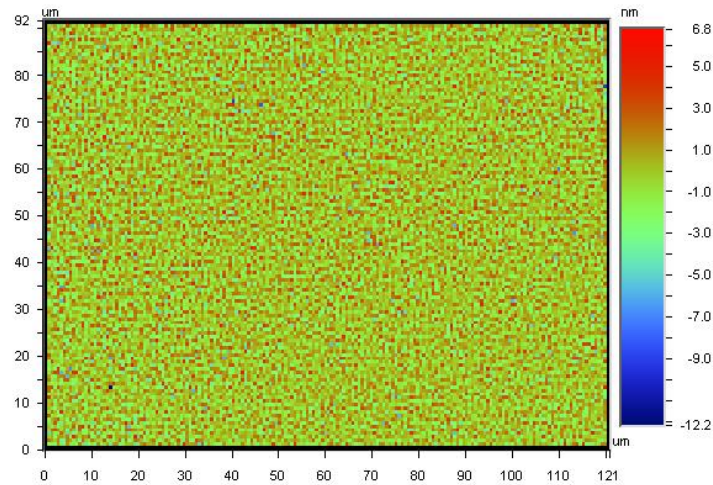
Ra: 1.38 nm  
Rq: 1.73 nm  
Rz: 13.96 nm  
Rt: 18.98 nm

### Set-up Parameters:

Size: 184 X 120  
Sampling: 660.40 nm

### Processed Options:

Terms Removed:  
Cylinder & Tilt



# 3-D Microroughness of PVD-Si on the C-SiC Composite



Mag: 50.9 X  
Mode: VSI

## 3D Plot

Date: 05/08/20  
Time: 12:35:2

### Surface Statistics:

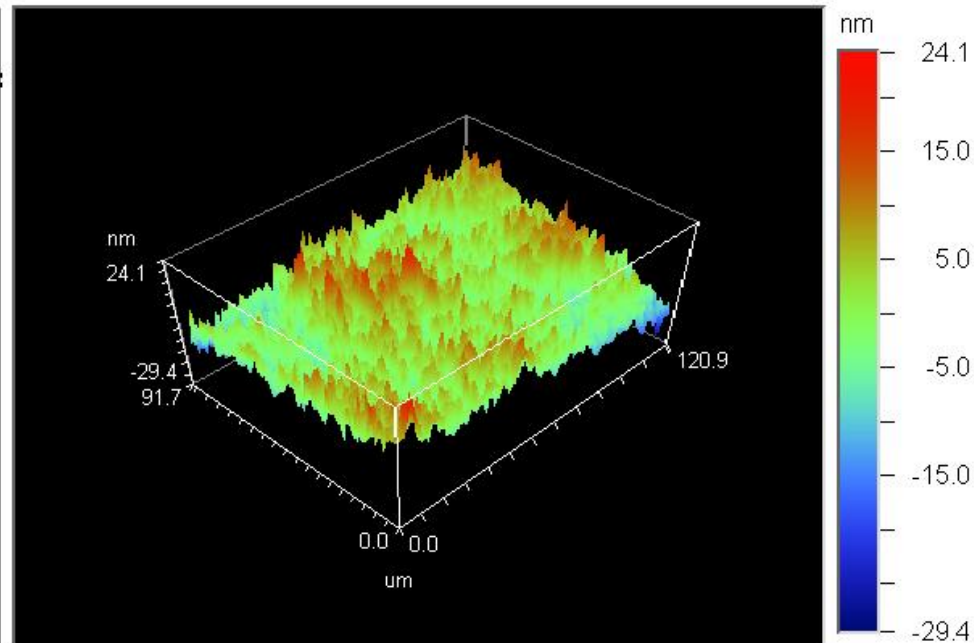
Ra: 4.41 nm  
Rq: 5.60 nm  
Rz: 40.53 nm  
Rt: 53.56 nm

### Set-up Parameters:

Size: 184 X 120  
Sampling: 660.40 nm

### Processed Options:

Terms Removed:  
Tilt  
Filtering:  
None





# Laser Testing:

1.5” cylindrical coupons are being  
fabricated for HELSTF testing